

September 23, 1997

Mr. William F. Caton
Office of the Secretary
Federal Communications Commission
1919 M Street, NW, Room 222
Washington, D.C. 20544

CC: 96 45

RECEIVED

JAN - 4 1999

Re: xDSL Presentation to the Commission

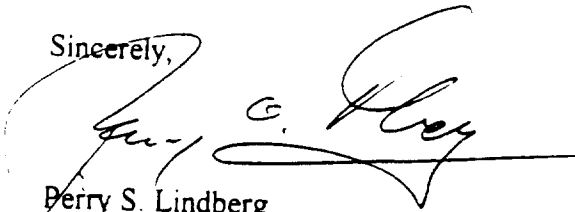
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Dear Mr. Caton:

On September 19, 1997, the Commission was introduced to xDSL Technologies. The presentation was held by myself and the content covered is attached.

An original and one copy of this letter and presentation overheads are being submitted to the Secretary of the FCC. One copy is being submitted to Vaikunth N. Gupta of the Universal Service Branch for further distribution to the attendees below.


Sincerely,


Perry S. Lindberg
Vice President, Strategic Programs

Attachment

cc: Vaikunth Gupta
Bryan Clopton
Bob Loube
C. Anthony Bush
Bill Sharkey
Chuck Keller
Natalie Wales
Emily Hoffner

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PAIRGAIN

THE COPPEROPTICS COMPANY

COPPEROPTICS®

**Digital transmission at fiber optic quality over
unconditioned copper wire**

Agenda

- ◆ xDSL Market
- ◆ xDSL Tutorial
- ◆ xDSL vs. ISDN
- ◆ Key Applications/Considerations for xDSL
- ◆ xDSL Financial Models
- ◆ xDSL Market Development
- ◆ Service Pricing
- ◆ Summary

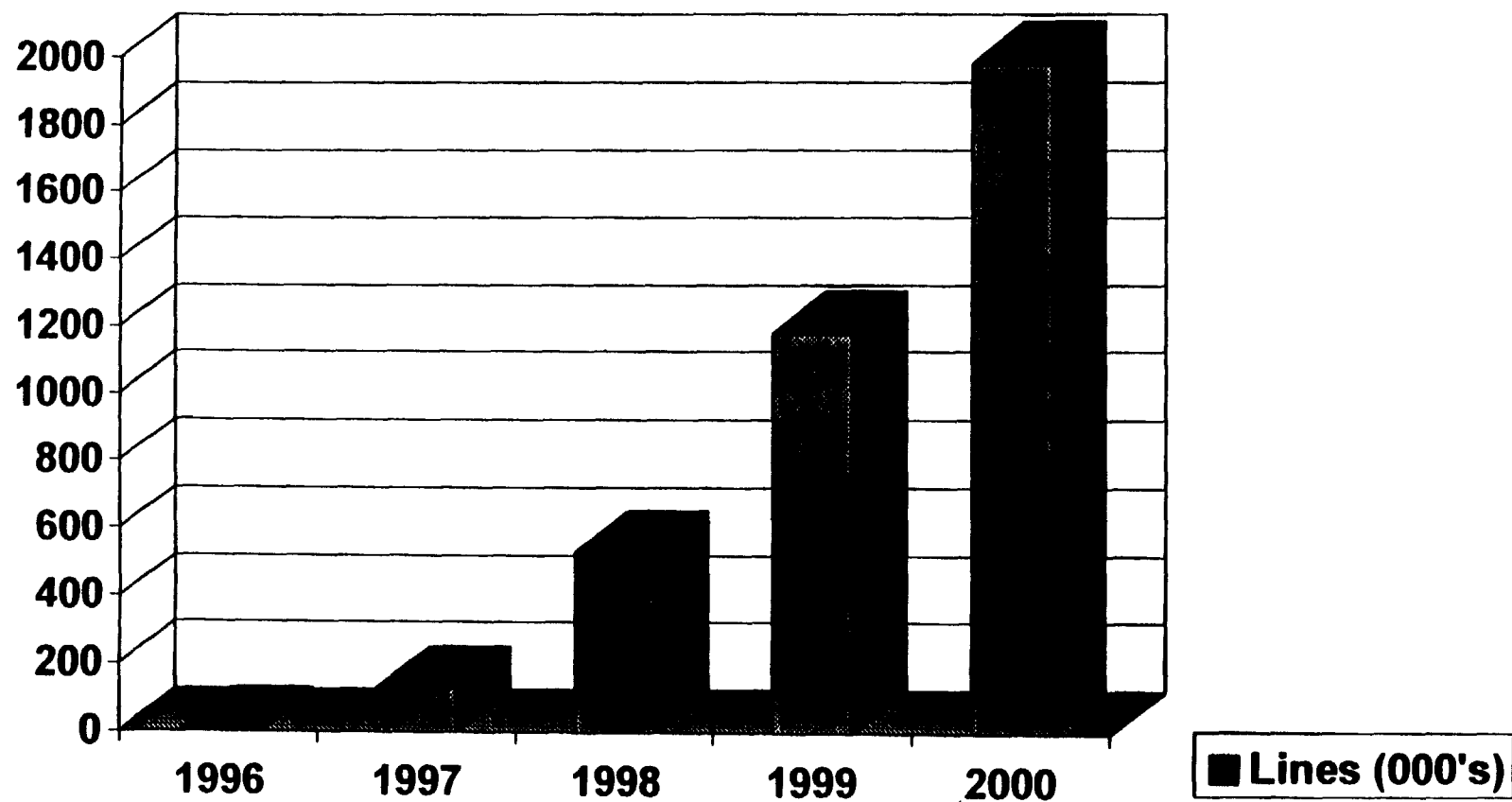
Market Hype



xDSL Megabit Access

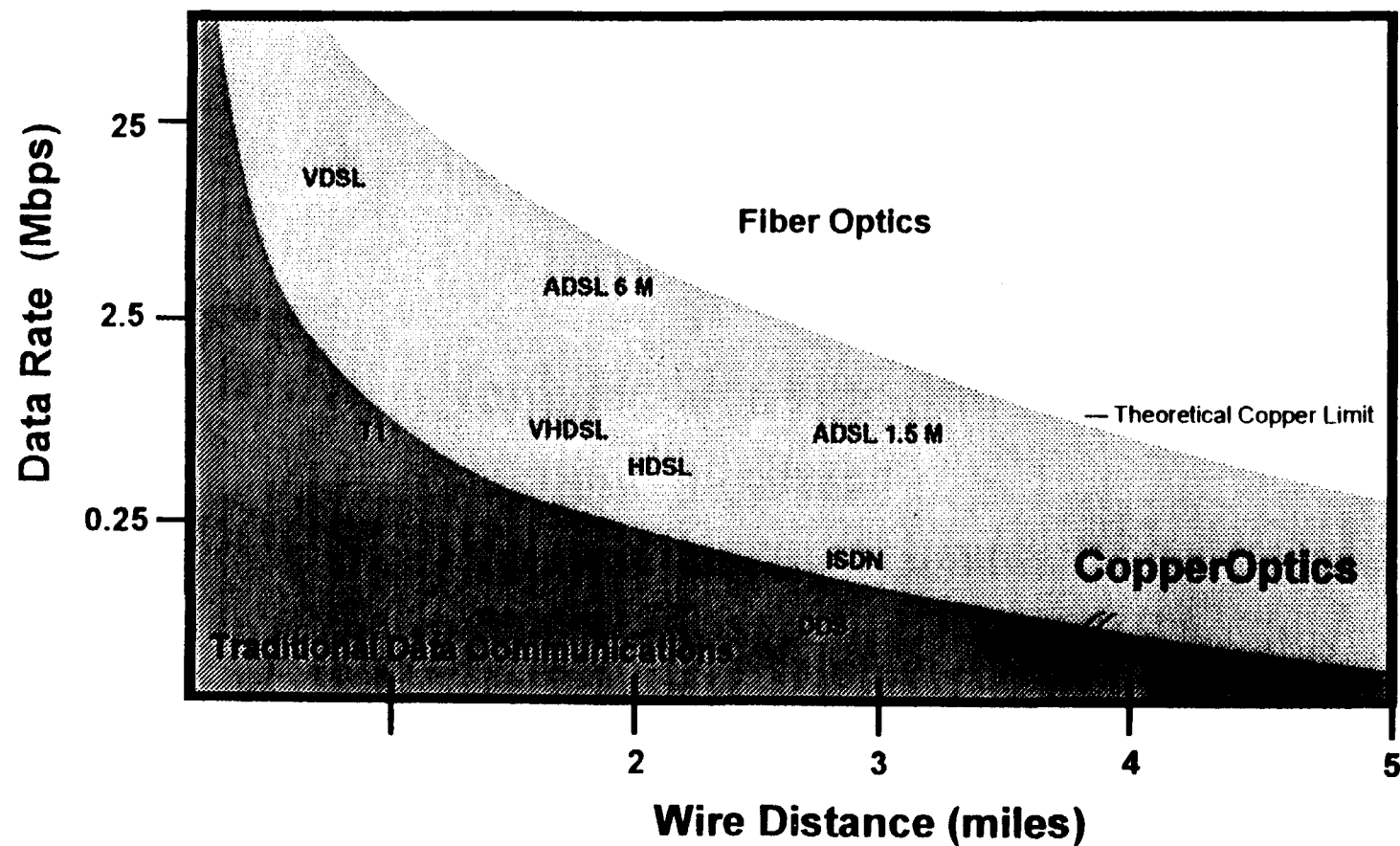
- ◆ High-speed digital transmission - data/video/voice
 - Symmetric and Asymmetric
 - Rates from 384 kbps up to 6 Mbps
- ◆ Uses existing unconditioned twisted-pair copper
 - High reliability and performance (10^{-10} BER)
 - Crosstalk immunity
- ◆ Extended distances beyond CSA - up to 5 miles
- ◆ Low cost

xDSL Market Forecast - Lines



Source: Yankee Group

Market Opportunity



Deployment Infrastructure Exists

- ◆ 690 million phone lines worldwide
 - 172 million in United States
 - 203 million in Europe
 - 138 million in Pacific Rim

xDSL vs. ISDN

	xDSL	ISDN
Installed Base	400,000 lines	1,000,000 lines
Bandwidth	128 kbps to 7 Mbps	128 kbps
Infrastructure	Local Area Network (LAN)	Addition to voice switch
Packet vs. Circuit Switched	Packet switched	Circuit switched
POTS	Lifeline	No
Reach	12 to 22 kft (24 AWG)	18 kft (24 AWG)

xDSL Technologies

- ◆ **High-bit-rate Digital Subscriber Line (HDSL)**
 - Two-pair technology using 2B1Q line code (signaling)
- ◆ **Single-Pair HDSL (S-HDSL)**
 - Single-pair technology using 2B1Q line code (signaling)
- ◆ **Asymmetric Digital Subscriber Line (ADSL)**
 - Carrierless Amplitude Modulation/Phase Modulation (CAP)
 - This is the line code used by the GlobeSpan chipset
 - Discrete Multi-Tone (DMT)
 - This is the official line code in the ANSI standard
- ◆ **Symmetric Digital Subscriber Line (SDSL)**
 - This is GlobeSpan's CAP technology configured to operate in symmetric mode
- ◆ **Rate Adaptive Digital Subscriber Line (RADSL)**
 - This adaptation of the ADSL technologies automatically provides the best transmission rate for the length and condition of the line

Rates, Reaches & Spectral Compatibility

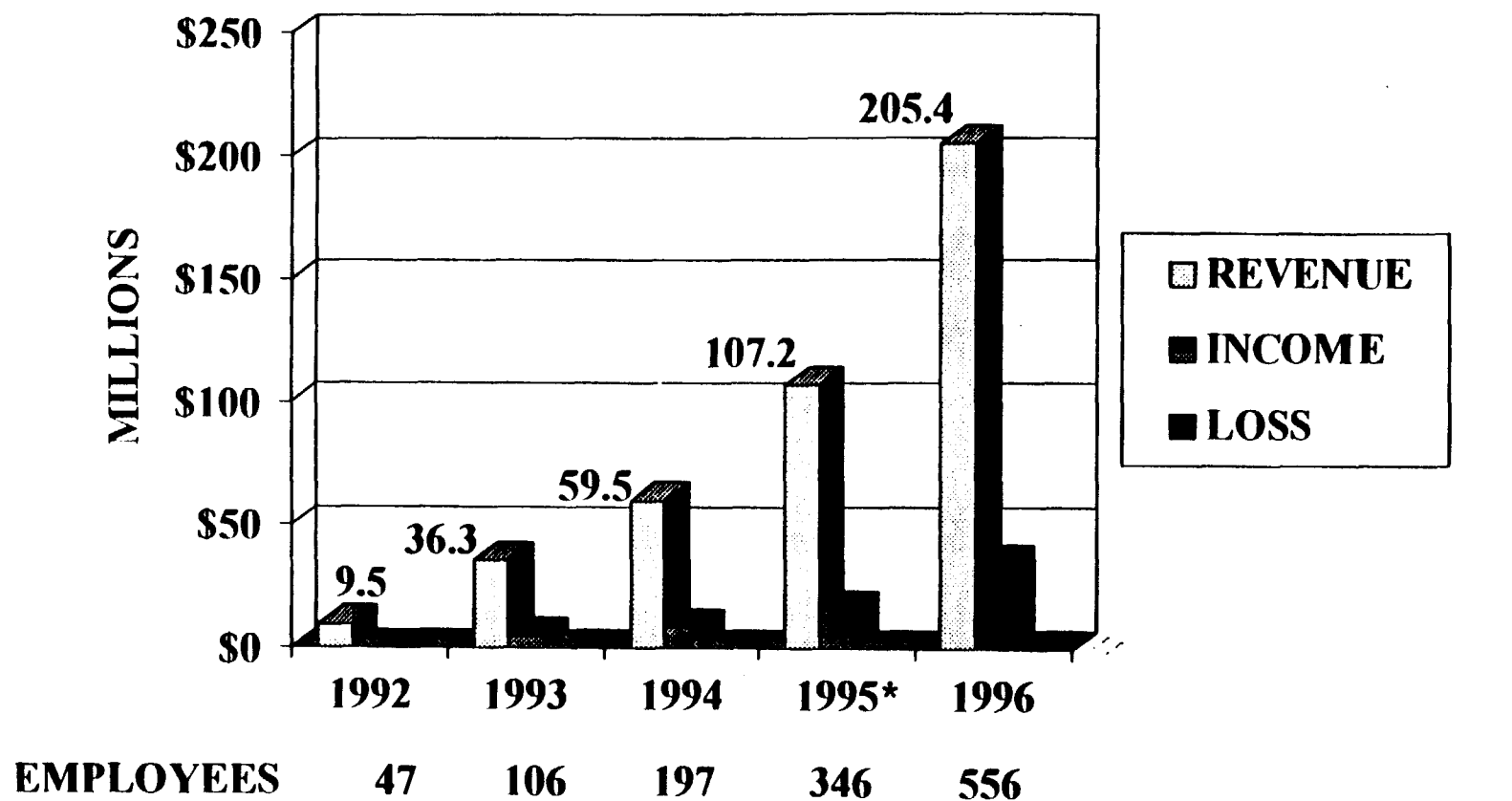
xDSL Type	Nominal Reach 26AWG	Repeater - able?	Maximum Downstream Rate (kbps)	Maximum Upstream Rate (kbps)	Spectral Compatibility			
					T1*	Adj Binder T1*	HDSL	ISDN
ISDN	RRD - 15.6 kft	✓	144	144	✓	✓	✓	✓
S-HDSL 768	CSA - 9 kft	✓	768	768	✓	✓	✓	✓
DMT ADSL	13.5 kft		1544	176	11 kft	✓	12 kft	✓
DMT ADSL	CSA		6144	640	4.5 kft	7.2 kft	✓	✓
CAP 1.5M/64	13.5 kft		1544	64	9.5 kft	12.7 kft	12 kft	✓
CAP 6M/64	CSA		6312	64	4.5 kft	7.2 kft	✓	✓

* Reaches reflect 10 T1 or Adj. T1 disturbers, HDSL reaches are 49 disturbers

PairGain Today

- ◆ 400,000+ units installed
- ◆ 75%+ domestic market share
- ◆ Approved by all RBOCs
 - Sole/primary source to five RBOCs
- ◆ STENTOR standard
- ◆ High volume, low-cost producer
- ◆ Feature-rich technology leader
- ◆ 80%+ annual growth rate
- ◆ 90% of customer deliveries - 48 hours ARO

Company Growth




* Excluding unauthorized trading losses

PairGain's xDSL Solutions

- ◆ **T1/E1 HDSL - HiGain**
 - Over 200,000 systems installed, 70% market share
 - Approved by all RBOCs and most major independents
- ◆ **Small Subscriber Carrier - PG-2, PG-Flex, PG-Plus**
 - Copper pair shortage
- ◆ **Campus Area Networks - Campus**
 - Universities, military bases, corporate campuses
- ◆ **Megabit Access - Megabit Modem/EtherPhone**
 - Internet Access - Consumer and business
 - Telecommuting
 - Remote LAN access (TLS)

xDSL Applications

Internet Surfing 



Remote LAN Access

Desktop Video Conferencing



Collaborative Computing

Email



Distance Learning

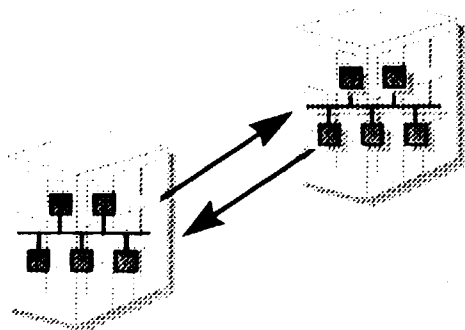
Telemedicine 

Application Response Times

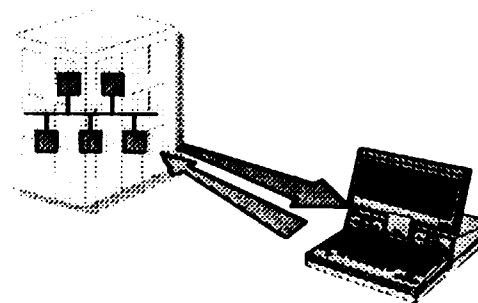
APPLICATION	FILE SIZE	Modem 28.8 kbps	ISDN 128 kbps	xDSL 384 kbps	xDSL 768 kbps	xDSL 1544 kbps	xDSL 6144 kbps
All users		8.3 Sec.					
Email							
Consumer		34.7 Sec.	7.8 Sec.				
Digitized Photo							
Business User		69.4 Sec.	15.6 Sec.	5.2 Sec.			
Word files							
Telecommuter		No	No				
Videoconferencing							
Telemedicine		26.3 Min.	52.1 Min.	1.7 Min.	52.1 Sec.		
X-ray							
Rem LAN Access		1.5 Hours	20.3 Min.	6.9 Min.	3.5 Min.	1.7 Min.	
Bulk File							

Desired and acceptable response time is less than 3.0 seconds

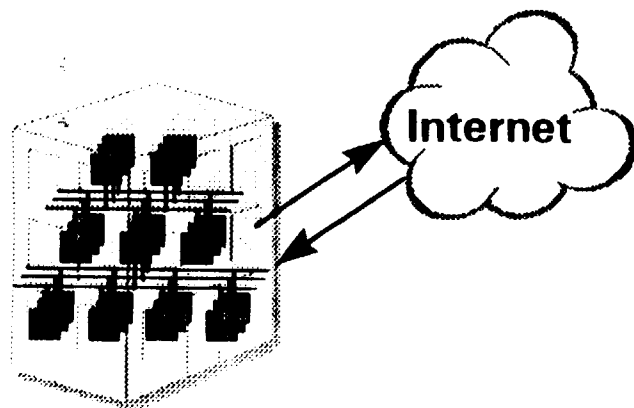
xDSL Services



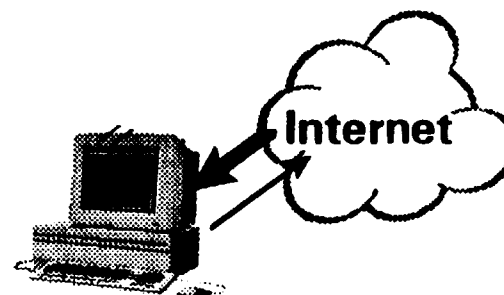
Transparent LAN Service



Telecommuter / SOHO

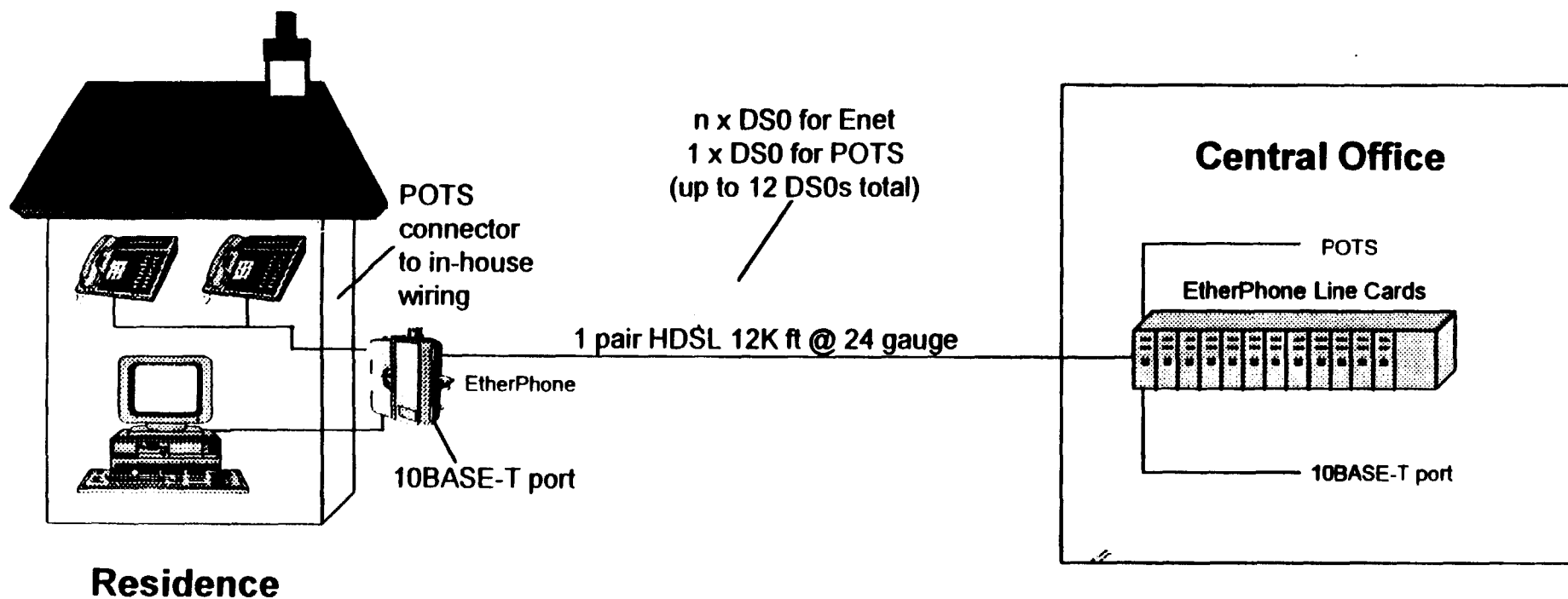


Business Internet



Consumer Internet

EtherPhone™ RT



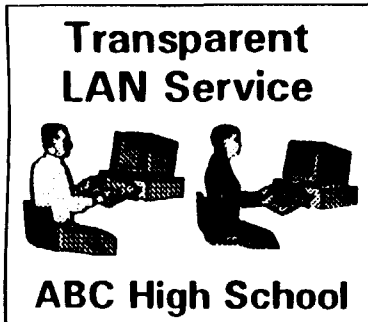
Worldwide Internet Users Growing

- ◆ Just 36 million Internet users today
- ◆ More than 100 million in 1998
- ◆ Close to 250 million in 2000

Service Pricing Expectations

- ◆ Initial pricing high (\$100+) and aimed at businesses
- ◆ Consumer-based services in \$30-\$50 range emerge in 1997
- ◆ Unlimited access but perhaps at fixed rates

ABC School District - Transparent LAN Service



Use/purpose

Connect together Ethernet networks in different buildings to share traffic

Network Description

Two or more LANs bridged to a common LAN backbone via dedicated xDSL circuits

Symmetrical/Asymmetrical

Symmetrical

Deployment Timeframe

NOW

Typical Price Range

\$200 to \$1,000/month per line

Equipment Considerations/Other

Transparent LAN service users usually require dedicated bandwidth

ABC School District - Telecommuter/SOHO



Use/purpose

Allow distance learning, on-line homework, library access, tutoring, assignment review

Network Description

Connect a remote PC to the school server/central LAN via a dedicated xDSL circuit

Symmetrical/Asymmetrical

Usually symmetrical

Deployment Timeframe

NOW for "high-end" users

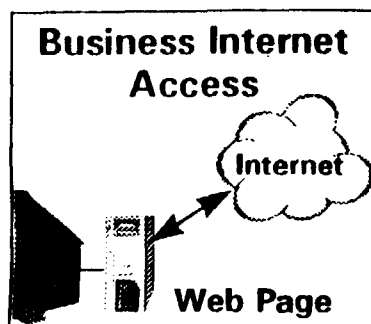
Typical Price Range

\$100 to \$300/month per line

Equipment Considerations/Other

Moderate "oversubscription" OK

ABC School District - Business Internet



Use/purpose

On-line research projects for students, teachers. High-speed access to Web page

Network Description

LAN-attached PCs and Web page server share a high-speed symmetrical line to ISP

Symmetrical/Asymmetrical

Symmetrical

Deployment Timeframe

NOW

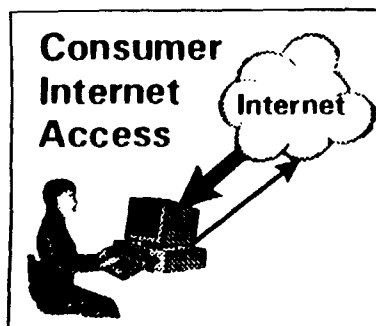
Typical Price Range

\$300 to \$1,000/month per line

Equipment Considerations/Other

School district may require dedicated bandwidth to Internet backbone

Consumer - High-Speed Internet Access



Use/purpose

Consumers "surf the net" from home with high-performance access

Network Description

LAN-attached PCs in user's home share a high-speed asymmetrical line to ISP

Symmetrical/Asymmetrical

Usually asymmetrical

Deployment Timeframe

Two to three years

Typical Price Range

\$20 to \$50/month per line

Equipment Considerations/Other

High oversubscription ratios and high density, low cost concentration required

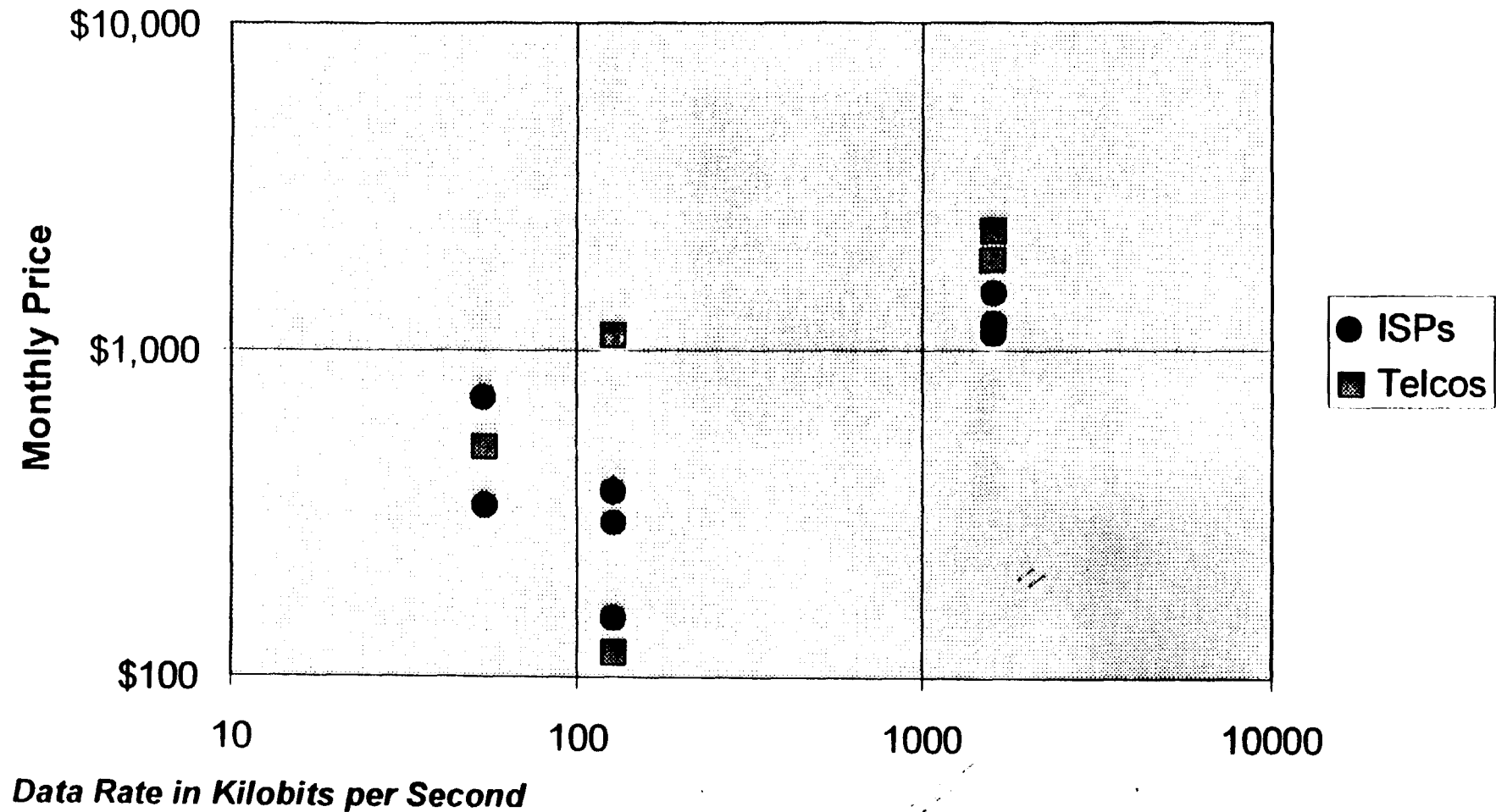
Business Model Summary

	Remote LAN Service	Telecommuter	Business Internet	Consumer Internet
Amortized Equipment and Leasing Costs	\$203/month	\$108/month	\$84/month	\$13/month
Capitalization Period	2 Years	2 Years	2 Years	10 Years
Monthly Subscriber Fee	\$500	\$200	\$400	\$25
Installation Fee	\$500/site	\$200/site	\$500/site	\$50/site
Gross Margin	63%	56%	79%	49%
Subscriber Base	100	500	500	10,000
Monthly Profit (from typical subscriber base)	\$31,500	\$56,000	\$158,000	\$122,500

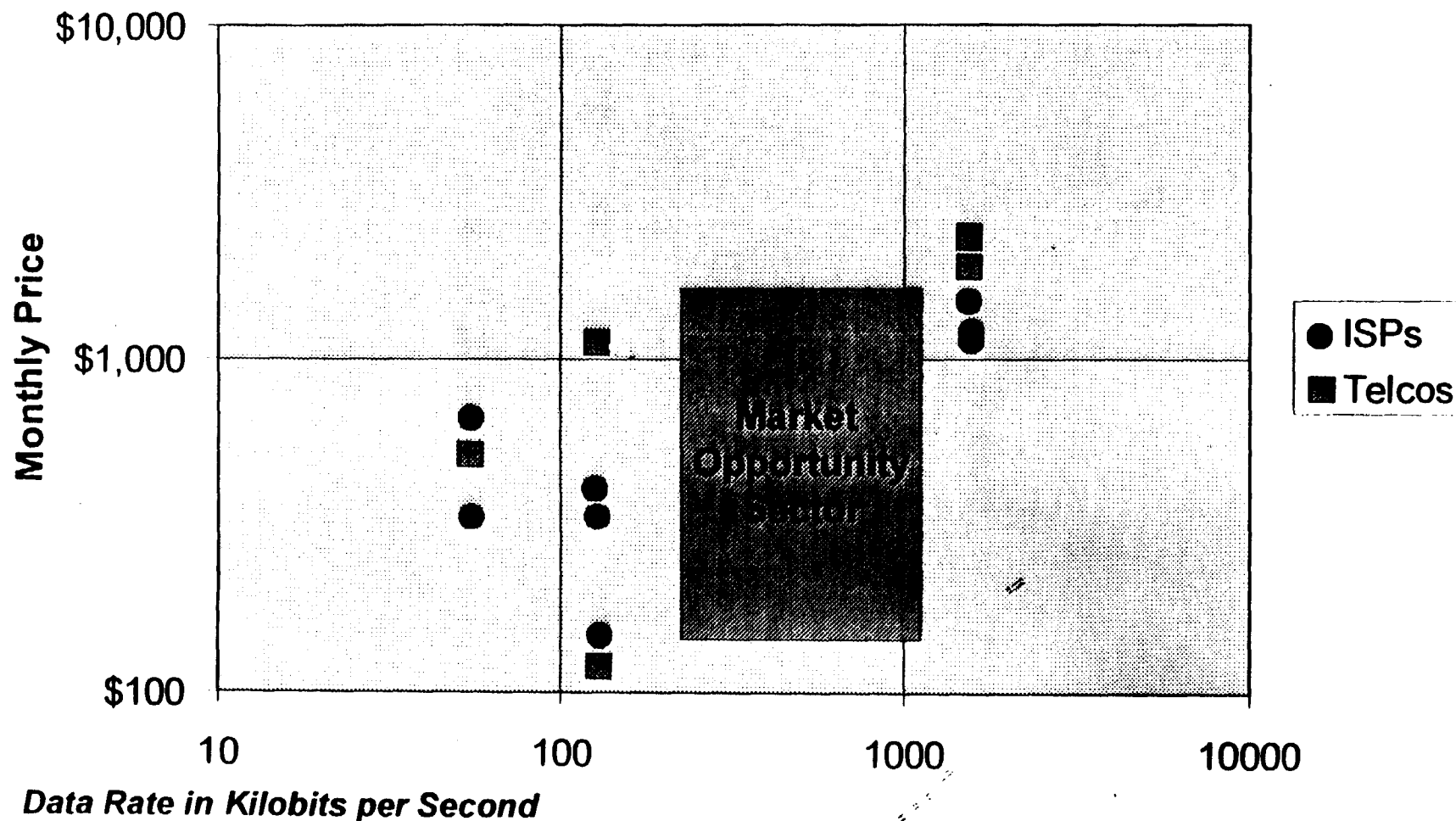
DSL Summary

- ◆ Current efforts too technology focused
 - Learn from ISDN mistakes
 - Stress DSLs strategic advantage; not tactical
- ◆ Bundle applications when possible
 - The Web alone won't fuel DSLs growth
- ◆ Businesses first, residences later
 - More demand for bandwidth in the Enterprise

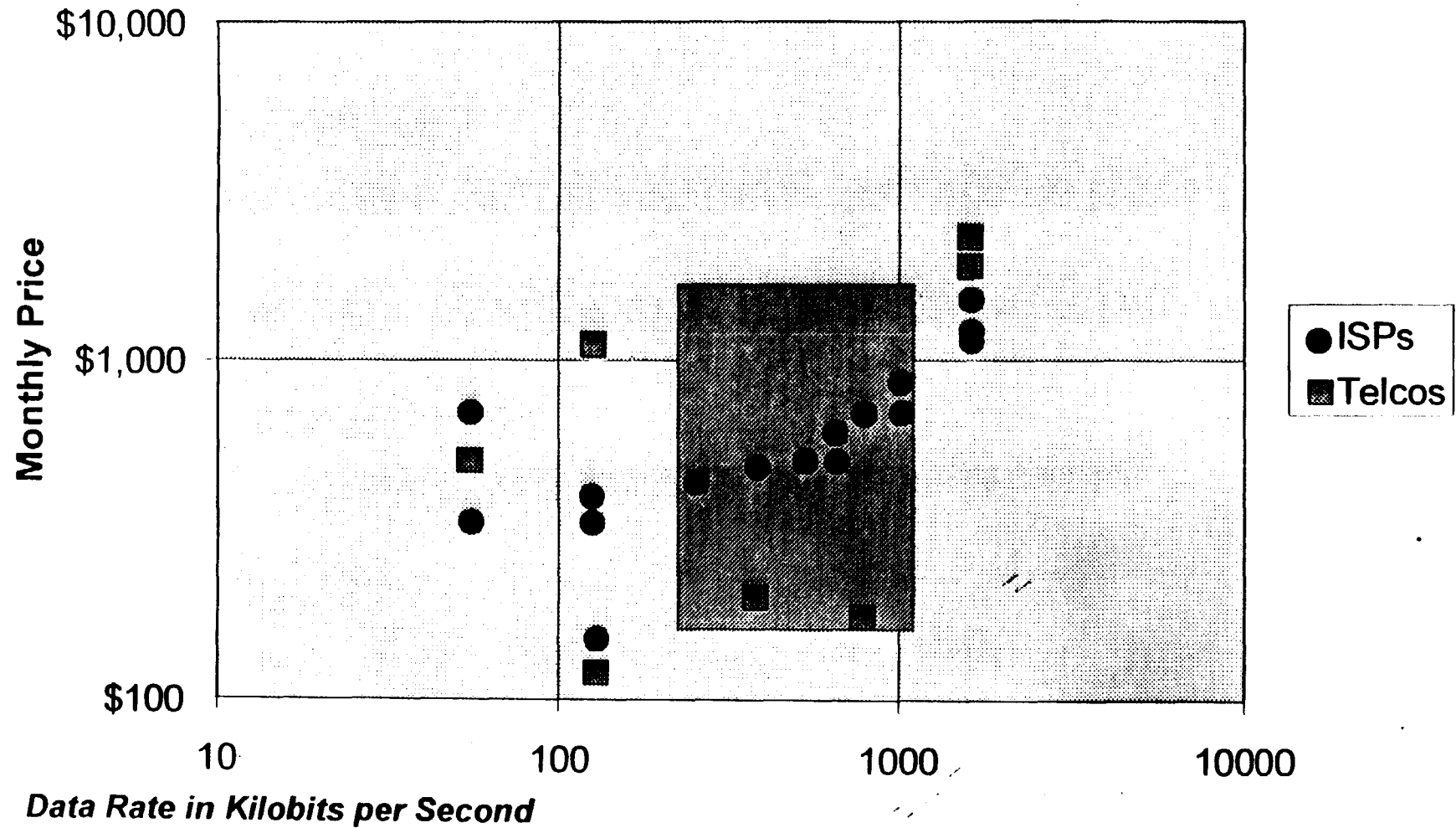
Non-xDSL Service Prices Today



Service Price / Performance Market Space



Current xDSL Service Prices



Establishing xDSL Service Pricing

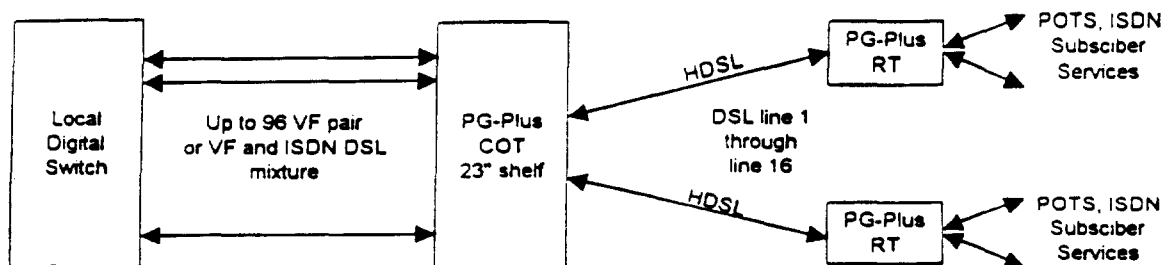
- ◆ Position xDSL-based service as part of a “family” of services
- ◆ Use a formula to maintain price “coherency” between services
- ◆ Use market-based pricing whenever possible
- ◆ Expect some cannibalization - be sure to keep your customers

xDSL - Key Messages

- ◆ Demand in the market - NOW
- ◆ Money to be made - NOW
- ◆ “Killer” applications already here
- ◆ xDSL will start first with businesses
- ◆ xDSL provides new ways to expand and differentiate your service offering

PG- PLUS™ LIST PRICING (con't.)

PG-Plus UDLC Configuration



Pricing Model: Sixteen 6-Channel POTS Only Systems, 23" COT Shelf, and Alarm Unit

Model	Part Number	CLEI Code	Unit Description	Quantity	List Price	
					Unit	Extend
PCS-719 List 1	150-1619-01	S9MTAB0ARA	23" COT Shelf Amphenol Subscriber Connectors	1	\$785	\$78
PAU-710 List 1	150-1610-01	S9C3AA0AAA	Alarm Unit Craft Maintenance Port	1	\$450	\$45
PLL-721 List 1	150-1621-01	S9L1AB0AAA	COLU - 6 DS0 6 POTS	16	\$1,355	\$21.68
PRL-771 List 1B	150-1671-21	S9MSBB0ARA	RU - 6 DS0 6 POTS	16	\$1,800	\$28.80
					System Price:	
					Price per POTS Channel (96 channels):	
					\$51.71	
					\$53	

PG-FLEX™ LIST PRICING (con't.)

Example #1 - One 24-Channel POTS Only System, 23" COT Shelf, Alarm Unit, RT with Protectors and IDT

Model	Part Number	CLEI Code	Unit Description	Quantity	List Price	
					Unit	Extend
FCS-719 List 4A	150-1319-41	VAMCHE0ARA	23" CO Shelf (Amphenol, Split Power, Straight)	1	\$1,025.00	\$1,025.00
FLL-712 List 3	150-1312-03	VACHDFHCAA	24 Ch. COLU (POTS, LS/GS, ISDN, PGTC)	1	\$2,300.00	\$2,300.00
FLC-703 List 3	150-1303-03	VACHCDGCAA	8 Ch. POTS COCU (u-Law, PGTC)	3	\$1,310.00	\$3,930.00
FAU-728 List 2	150-1328-02	Not Required	Alarm Unit (Composite Clock)	1	\$395.00	\$395.00
FRE-765 List 4A	150-1365-41	VAMRBN0ARA	24 Ch. RT Enclosure (Prot. Strips, IDT, Straight)	1	\$1,315.00	\$1,315.00
FRL-742 List 3	150-1342-03	VARHDFHCAA	24 Ch. RTLU (POTS, LS/GS, ISDN, PGTC)	1	\$2,300.00	\$2,300.00
FRC-753 List 2	150-1353-02	VARHCGGCAA	8 Ch. POTS RTCU (u-Law, PGTC)	3	\$1,420.00	\$4,260.00
					System Price:	\$15,525.00
					Price per Channel (24 channels):	\$646.88

Example #2 - Four 24-Channel POTS Only Systems, 23" COT Shelf, Alarm Unit, RTs with Protectors and IDT

Model	Part Number	CLEI Code	Unit Description	Quantity	List Price	
					Unit	Extend
FCS-719 List 4A	150-1319-41	VAMCHE0ARA	23" CO Shelf (Amphenol, Split Power, Straight)	1	\$1,025.00	\$1,025.00
FLL-712 List 3	150-1312-03	VACHDFHCAA	24 Ch. COLU (POTS, LS/GS, ISDN, PGTC)	4	\$2,300.00	\$9,200.00
FLC-703 List 3	150-1303-03	VACHCDGCAA	8 Ch. POTS COCU (u-Law, PGTC)	12	\$1,310.00	\$15,720.00
FAU-728 List 2	150-1328-02	Not Required	Alarm Unit (Composite Clock)	1	\$395.00	\$395.00
FRE-765 List 4A	150-1365-41	VAMRBN0ARA	24 Ch. RT Enclosure (Prot. Strips, IDT, Straight)	1	\$1,315.00	\$1,315.00
FRL-742 List 3	150-1342-03	VARHDFHCAA	24 Ch. RTLU (POTS, LS/GS, ISDN, PGTC)	4	\$2,300.00	\$9,200.00
FRC-753 List 2	150-1353-02	VARHCGGCAA	8 Ch. POTS RTCU (u-Law, PGTC)	12	\$1,420.00	\$17,040.00
					System Price:	\$53,890.00
					Price per Channel (24 channels):	\$558.83